

091936210

Copy for the elected Office (EO/US)

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

COMMUNICATION IN CASES FOR WHICH
NO OTHER FORM IS APPLICABLE

To:

GARRISON, Christopher, Sinclair
 BT Group Legal Services
 Intellectual Property Dept.
 8th floor, Holborn Centre
 120 Holborn
 London EC1N 2TE
 ROYAUME-UNI

Date of mailing (day/month/year) 08 November 2001 (08.11.01)	
Applicant's or agent's file reference A25770 WO	REPLY DUE see paragraph 1 below
International application No. PCT/GB00/01078	International filing date (day/month/year) 22 March 2000 (22.03.00)
Applicant BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY	

1. REPLY DUE within _____ months/days from the above date of mailing
 NO REPLY DUE, however, see below
 IMPORTANT COMMUNICATION
 INFORMATION ONLY
2. COMMUNICATION:

It has been brought to the attention of the International Bureau that in respect of the above-identified application, the international publication No. WO 00/59177 published on 05 October 2000 (05.10.00) erroneously indicated the country code of the second priority claim (numbered 99305557.3) as GB. The correct code is EP.

The International Bureau shall republish a correction in Section II of the PCT Gazette. A corrected version of the corresponding PCT pamphlet will be published as early as possible.

A copy of this Notification is being sent to the receiving Office (RO/GB) and to the designated/elected Offices concerned.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer Anman QIU Telephone No. (41-22) 338.83.38
--	--

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION
(PCT Rule 61.2)

Date of mailing: 05 October 2000 (05.10.00)	To: Assistant Commissioner for Patents United States Patent and Trademark Office Box PCT Washington, D.C.20231 ETATS-UNIS D'AMERIQUE in its capacity as elected Office
International application No.: PCT/GB00/01078	Applicant's or agent's file reference: A25770 WO
International filing date: 22 March 2000 (22.03.00)	Priority date: 31 March 1999 (31.03.99)
Applicant: WRIGHT, Trevor et al	

1. The designated Office is hereby notified of its election made:

in the demand filed with the International preliminary Examining Authority on:
28 July 2000 (28.07.00)

in a notice effecting later election filed with the International Bureau on:

2. The election was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer: J. Zahra Telephone No.: (41-22) 338.83.38
---	---

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference A25770 WO	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 00/01078	International filing date (<i>day/month/year</i>) 22/03/2000	(Earliest) Priority Date (<i>day/month/year</i>) 31/03/1999
Applicant BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
 - the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :
 - contained in the international application in written form.
 - filed together with the international application in computer readable form.
 - furnished subsequently to this Authority in written form.
 - furnished subsequently to this Authority in computer readable form.
 - the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
 - the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. Certain claims were found unsearchable (See Box I).

3. Unity of Invention is lacking (see Box II).

4. With regard to the title,

- the text is approved as submitted by the applicant.
- the text has been established by this Authority to read as follows:

SERVER COMPUTER FOR GUARANTEEING FILES INTEGRITY

5. With regard to the abstract,

- the text is approved as submitted by the applicant.
- the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

- as suggested by the applicant.
- because the applicant failed to suggest a figure.
- because this figure better characterizes the invention.

None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/01078

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04L G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 835 943 A (DORWORTH GORDON L ET AL) 10 November 1998 (1998-11-10)	1,2,5-8
A	abstract column 2, line 41-61 column 6, line 8-37 column 8, line 5-23 column 13, line 30-43 figures 6-8 ---	3,4
P, X	EP 0 915 600 A (HITACHI LTD) 12 May 1999 (1999-05-12) column 4, line 35-57 column 10, line 53 -column 11, line 16 column 12, line 36 -column 13, line 34 column 15, line 49 -column 16, line 4 column 21, line 51 -column 22, line 5 column 22, line 29-39 ---	1-3,5-8 -/-

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

& document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

13 July 2000

21/07/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.
Fax: (+31-70) 340-3016

Authorized officer

Lázaro López, M.L.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/01078

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 781 711 A (KULBIDA CHRISTOPHER ET AL) 14 July 1998 (1998-07-14) abstract column 5, line 62 -column 6, line 42 -----	1-8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/01078

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 5835943	A 10-11-1998	US 5682514 A		28-10-1997
		US 6012085 A		04-01-2000
EP 0915600	A 12-05-1999	JP 11143840 A		28-05-1999
US 5781711	A 14-07-1998	US 5689625 A		18-11-1997
		EP 0777176 A		04-06-1997
		JP 9190319 A		22-07-1997

PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H04L 29/06	A1	(11) International Publication Number: WO 00/59177
(21) International Application Number:	PCT/GB00/01078	(43) International Publication Date: 5 October 2000 (05.10.00)
(22) International Filing Date:	22 March 2000 (22.03.00)	
(30) Priority Data:	9907442.9 31 March 1999 (31.03.99) 99305557.3 13 July 1999 (13.07.99)	GB GB
(71) Applicant (<i>for all designated States except US</i>):	BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY [GB/GB]; 81 Newgate Street, London EC1A 7AJ (GB).	(81) Designated States: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
(72) Inventors; and		Published
(75) Inventors/Applicants (<i>for US only</i>):	WRIGHT, Trevor [GB/GB]; 15 Ditchingham Grove, Rushmere St. Andrew, Ipswich, Suffolk IP5 1WE (GB). TEDESCHI, Nigel [GB/GB]; 32 Wolton Road, Kesgrave, Ipswich, Suffolk IP5 2YT (GB).	<i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(74) Agent:	GARRISON, Christopher, Sinclair, BT Group Legal Services, Intellectual Property Dept., 8th floor, Holborn Centre, 120 Holborn, London EC1N 2TE (GB).	

(54) Title: SERVER COMPUTER FOR GUARANTEEING FILES INTEGRITY

(57) Abstract

The problem of the vulnerability of electronic content stored on server computers to alteration by unauthorised third parties is one which has become much exacerbated with the advent of the Internet and the World Wide Web. Present day approaches, including approaches based on digital signature techniques, allow for the checking of content transmitted over communications networks to, for example, client computers, to establish if tampering by unauthorised third parties has occurred. Such approaches all suffer from the disadvantage that any content which has been tampered with is still transmitted over the network to the client computer before such a check takes place. According to the invention however, a server computer storing computer files, each computer file having an associated unique digital signature, receiving requests for access to one or more such computer files, only allows access to the or each computer file if their associated digital signatures are valid. Thus, if a computer file has been tampered with by an unauthorised third party, the digital signature associated with that computer file will prove to be invalid when checked and the server computer will not serve the computer file at all. In this way, a computer file that has been tampered with can never leave the server computer, much improving the security of the stored computer files.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		

SERVER COMPUTER FOR GUARANTEEING FILES INTEGRITY

The present invention relates to a method of and apparatus for the serving of computer files. It has application, in particular, to the secure serving of digitally signed computer files.

The notion of associating a sign of some form with a document or an object to denote, for example, authorship or ownership has long been in existence. It is an unfortunate reflection on human nature that the related notion of falsely associating a sign with a document or with an object to indicate false authorship or ownership has also long been in existence.

With the advent of the printing press and the printed document and, more recently, the digital or electronic computer and the digital or electronic document, the problems of the faithful reproduction and the convenient editing or alteration of documents have been much ameliorated.

As will be well known, a digital document can typically be altered or copied as many times as is wished without any change in quality since it is only the digital bits representing the information content of the document that are changing. If a digital document is created by a first party and then covertly altered by a second party, it may well be difficult for a third party subsequently reading the document to tell that it has been altered.

25

The advent of networked communication between computers and in particular the rise of the Internet and the World Wide Web has meant that vast numbers of computers all over the world can now communicate with each other using common protocols. Electronic documents are often now made available as Web Pages on a Web Site.

It will be well known that the World Wide Web (or simply 'Web' hereinafter) has a wide variety of associated concepts and standards. A rich source of information

relating to these concepts and standards is the World Wide Web Consortium (<http://www.w3c.org>), a body hosted by the Laboratory for Computer Science at the Massachusetts Institute of Technology (MIT). Concepts such as a 'Web Server', a 'Web Site', a 'Web Page', a 'Web Browser', a 'Hyperlink' and a 'Uniform Resource Locator' and standards such as the 'HyperText Transport Protocol (HTTP)' and the 'HyperText Markup Language (HTML)' will be well known.

A problem faced by those parties wishing to distribute content in the form of electronic documents or files, for example, on the World Wide Web, has been the vulnerability of the stored content to deliberate alteration by unauthorised third parties accessing the content over a communications network.

Should an unauthorised third party manage to access a given Web Server, they might, for example, edit a Web Page stored on that Web Server. When the Web Page is subsequently viewed with a Web Browser, the content of the Web Page would then reflect the message of the unauthorised third party rather than the original content provider.

It will be appreciated that a wide variety of motives may exist for unauthorised third parties to attempt to subvert the message delivered by a given piece of content but it is probably safe to assume that in all cases the content provider would prefer not to have the message delivered by its content tampered with and then presented to the browsing world as its own.

25 A first present day approach to tackling this problem of the vulnerability of stored content to alteration by unauthorised third parties might attempt to ensure that the stored content is never accessible to unauthorised third parties.

One example of this approach is the use of a so-called 'firewall'. As will be well known a firewall may be used to protect a computer connected to a network by controlling traffic between the computer and the network such that only certain types of traffic, as defined by the computer administrator, are allowed to pass from the network to the computer or vice versa. In theory this should prevent unauthorised

third parties from accessing the computer from the network such that they could alter the content stored on that computer. Naturally such a firewall cannot protect the stored content from alteration by a malicious user validly operating inside the firewall

- 5 In practice it will be well known that real-world implementations of firewalls are often far from secure.

A second approach, mindful of the fact that the content might have been altered either when stored or during transmission over a communications channel, is to

- 10 perform a check on downloaded content to see if it has been tampered with.

One simple example of this second approach is the use of a so-called 'checksum'. As will be well known a checksum is computed from a given block of data, yielding a value which is then associated with that block of data. If the checksum computation

- 15 is run again, any change in the data will cause a change in the checksum value.

Checksum methods are most often employed as a simple check to detect corruption during transmission of data. In theory then, when a given piece of content is downloaded along with an initial checksum value, a new checksum value can be computed for the downloaded content, which can then be compared with the original

- 20 checksum value sent along with the content. If the original checksum value and the newly derived checksum value are the same then there may be some confidence that the content has not been altered after the computation of the original checksum value, which might be either whilst stored or during transmission.

- 25 In practice it will be appreciated however, that any unauthorised third party able enough, for example, to access and tamper with stored content may well be able enough to alter the original checksum accordingly. If this were done then the checksum comparison performed when the content is downloaded would falsely indicate that the content had not been tampered with since its original storage.

30

More sophisticated examples of this second approach involve the use of so-called 'digital signatures'. The theory and practice of digital signatures have become very

well known over the past few years as the Internet and more particularly the World Wide Web have experienced exponential growth.

A treatment of digital signatures may, for example, be found in 'Applied

5 Cryptography: Protocols, Algorithms and Source Code in C' by Bruce Schneier, second edition 1996, John Wiley & Sons. A further treatment of digital signatures may be found in 'PGP: Pretty Good Privacy' by Simson Garfinkel, first edition 1995, O'Reilly & Associates. Terms such as 'public key', 'private key', 'hash function' and 'message digest function' will be well understood.

10

Digital signature techniques utilise so-called 'public key' cryptographic methods. As will be well known, public key cryptography uses an algorithmically related pair of keys, a so-called 'public key' and a so-called 'private key', to encrypt messages, rather than the single key of more traditional symmetric key cryptography. The public

15 key is intended to be widely distributed in the public domain whereas the private key must be kept absolutely secret. Crucially, knowledge of the public key does not allow the private key to be determined. Typically, a message encrypted with a public key is decrypted and can only be decrypted with the corresponding private key. The encryption process is symmetric however such that an encryption operation
20 performed with the private key can be decrypted with the public key. A successful decryption with a given public key guarantees that the message was encrypted with the matched private key.

Public key cryptography can be used to attempt to secure a communications channel
25 such that content transmitted over that channel cannot be intercepted and compromised. One example of such an application is the Secure Sockets Layer (SSL) protocol, originally developed by the Netscape Communications Corporation (Mountain View CA, USA). For communication between, for example, a client computer and a server computer, such a protocol first authenticates the server
30 computer using public key cryptography and then shares a symmetric key for use in encrypting all further communication between the client and server computers. A protocol such as SSL thus both protects against a first server computer pretending to be a second server computer and serving data falsely purporting to be from that

second server computer and prevents any unauthorised third party intercepting and altering communications during transmission. Such a protocol is, however, aimed at the securing of content during transmission, not at solving the problem of the stored content being vulnerable to alteration.

5

Digital signature techniques using public key cryptography allow checks not only as to 'authentication', guaranteeing that a digitally signed 'document' does in fact originate from the party whose signature the document bears but also as to 'integrity', guaranteeing that the contents of the document have not been tampered 10 with since the originating party digitally signed the document.

The process by which digital signatures are employed in order to perform a check on downloaded content to see if it has been tampered with will be discussed below in greater detail having regard to the invention. It will suffice at this point to consider 15 the functionality provided through the use of digital signatures in the following example of the second approach.

The Microsoft Corporation (Redmond WA, USA) has developed so-called 'Authenticode™'. Authenticode™ software is installed on client computers and is 20 directed towards checking software that has been downloaded over a network from, for example, a server computer, to see if the software has been tampered with in an unauthorised fashion. Each such piece of code will have been digitally signed. Having regard to a particular piece of digitally signed code downloaded over a network, before the installation or execution of the code, Authenticode™ may check the digital 25 signature to see if it is valid. A selection of a 'high', 'medium' or 'none' Authenticode™ safety setting must be made in the client software. With a 'high' setting Authenticode™ will not allow the installation or execution of code whose associated digital signature proves to be invalid. With, however, a 'medium' setting, Authenticode™ will warn the user that the code is 'untrustworthy' but will allow the 30 option of installing or executing it if the user wishes. With a safety setting of 'none', Authenticode™ provides no such warning.

As will be evident, an arrangement such as Authenticode™, checking code downloaded to a client at that client, can only go so far in protecting stored content. Such checking performed at the client will involve the sending of the content in question to the client computer. In this way, content that has been tampered with
5 will still be sent out over the network to the client. It may be that an arrangement such as Authenticode™ may be configured to deny the installation or execution of an 'untrustworthy' piece of code, but the code still exists at the client and it cannot be guaranteed that an able enough user could not access it. Alternatively, it is clear that such a configuration can be changed to allow the installation or execution of
10 'untrustworthy' code if so wished.

It will be appreciated that neither with the first approach to the problem of the content alteration (attempting to ensure that the stored content is never accessible to unauthorised third parties), nor with the second approach, (attempting to perform a
15 check on downloaded content to see if it has been tampered with), is it guaranteed that the altered content will not be seen.

In the first case if, for example, the relevant firewall had been breached and unbeknownst to the Web Site administrator the stored content had been altered, the
20 altered content would be viewed by anyone accessing the Web Page until such time as the Web Site administrator noticed or was informed of the alteration and took corrective action.

In similar fashion, in the second case if, for example, the digital signature
25 authentication of the relevant downloaded content had failed, then, as mentioned above, although the content will be deemed 'untrustworthy', it may well be open to the 'downloader' to view or otherwise execute the 'untrustworthy' altered content. Indeed, a situation can be imagined where the notoriety of a Web Page that had been tampered with by an unauthorised third party is the very reason for persons wanting
30 to view the Web Page, before the Web Site administrator can take corrective action. Again, even if the downloader is prevented from, for example, executing an untrustworthy file, that file has still been sent out over a network and it may well be possible to access a copy of the file at some point in the process.

In contrast with these present day approaches however, according to the invention there is provided a server computer comprising: means arranged to store one or more computer files; means arranged to store one or more digital signatures; each 5 computer file having an associated digital signature; means arranged to receive a request from at least one other computer for access to at least one computer file stored on said server computer; means arranged to retrieve the or each requested computer file; means arranged to retrieve the digital signature associated with the or each requested computer file; means arranged to validate the digital signature 10 associated with the or each requested computer file; and means arranged to provide said other computer with access to the or each requested computer file only when the digital signature associated with the or each respective requested computer file is valid.

15 Advantageously, in this way it is assured that if the computer file storage security is breached and one or more files tampered with, it will not be possible for any external party to see the results of the tampering. No access can be given to a computer file unless the digital signature associated with that computer file has been validated. In particular, no copy of a computer file can leave the file server computer where it is 20 stored unless the digital signature associated with that computer file has been validated. Thus, if the file has been tampered with, no external third party will be able to obtain a copy of it. There can be no possibility of the message or functionality of the original computer file being subverted by an unauthorised third party to their own ends.

25

A method of operating a server computer is also provided.

An embodiment of the invention by way of example will now be discussed with reference to the accompanying drawings in which:

30

Figure 1A represents first and second conventional computers connected to a communications network;

Figure 1B represents such a conventional computer;

Figure 2 illustrates a procedural flowchart for the digital signing of a digital document;

- 5 Figure 3 illustrates the entities involved in the process of Figure 2;

Figure 4 illustrates a procedural flowchart for the serving of digitally signed documents;

- 10 Figure 5 illustrates a procedural flowchart for the authentication of the digital signature of a digitally signed document; and

Figure 6 illustrates the entities involved in the process of Figure 5.

- 15 Figure 1A illustrates a conventional general purpose computer 100, suitable for use as a Web Server. Such a computer 100 is illustrated in Figure 1B and will typically have at least a central processing unit (CPU) 102, read-only memory (ROM) 104, random-access memory (RAM) 106, a storage device such as a hard disk 108, a device for reading from and writing to storage media such as a floppy disk drive 110 for reading
20 from and writing to floppy disks and input and output ports 112 for connection to other devices or communications networks.

Returning to Figure 1A, a floppy disk 114 is indicated for the floppy disk drive 110 to read from or write to. The computer 100 is connected to a communications network
25 116, which in this embodiment is to be understood as the well known Internet, utilising, for example, Transmission Control Protocol/ Internet Protocol (TCP/IP). A second conventional general purpose computer 118, suitable for use as a Web Client, is similarly connected to the Internet communications network 116.

- 30 The computer 100 may utilise any suitable operating system, well known examples being Microsoft Windows™ NT , Linux or any one of the other many versions of Unix. Application programs may be written in any of many well known suitable languages in which to write application programs, one well known example of which is C++.

Such an operating system and application programs may be loaded onto the storage device 108 of the computer 100.

The functionality disclosed in accordance with this embodiment of the invention may
5 be implemented as a software module application program to be executed by the computer 100. This software application program may then be stored in any suitable computer readable storage media form, for example on floppy disk 114, for loading into the computer 100, via the floppy disk drive 110, for execution. A well known alternative would be to store the software application on a CD-ROM (not shown) for
10 loading into the computer 100 via a CD-ROM drive (not shown) for execution. A further well known alternative would be to download the software application program over the network 116, for execution by the computer 100.

In this embodiment the computer 100 has one or more software application programs
15 loaded onto it which, when executed, will cause the computer 100 to operate as a Web Server. One or more Web Documents will be stored on the appropriate storage device of the Web Server, as is conventional.

One or more software application programs loaded onto the second computer 108,
20 including a Web Browser program, when executed, enable communication using World Wide Web protocols and in particular allow the viewing of Web Pages, for example those hosted on the Web Server computer 100, using a Web Browser.

A conventional digital signing process will now be discussed having regard to Figures
25 2 and 3. It will be appreciated that the structure of Figures 2 and 3 is mirrored; Figure 2 illustrates a procedural flowchart of the process of the digital signing of a digital or electronic document whilst Figure 3 illustrates in simple fashion the behaviour of the corresponding entities. It will be further appreciated that the steps indicated in the procedural flowchart will be carried out through execution of the software application
30 running on the Web Server 100.

By way of example in this embodiment, the Web Documents considered are Web Pages, typically HyperText Markup Language (HTML) documents, stored on the

appropriate storage device of the Web Server 100, in this example, the hard disk. It is to be noted however that this example is non-limiting; many other forms of computer file are equally able to be treated according to the invention (including, for example, documents of formats other than HTML, images in, for example, Joint Photographic

- 5 Experts Group (JPEG) format and downloadable software programs).

In first step 200 a document is selected for digital signing. Such a document 300 is illustrated in Figure 3.

- 10 In a second step 202, the document to be signed is run through a so-called 'hash' function. The hash function derives a short representation of the document, which is often referred to as the 'hash' of the document. The document to be signed 300 and the hash of the document to be signed 302 are figuratively illustrated in Figure 3. The hash function and the hash of the document are often alternatively referred to as the
15 'message digest' function and the 'message digest' respectively. Two well known examples of hash functions are the MD5 and SHA hash functions.

It will be well known that the hash of a document produced by a hash function is remarkably sensitive to the contents of the document. If, for example, a text
20 document is altered by so much as the insertion of a full stop, then a hash generated before the insertion of the full stop and a hash generated after the insertion of the full stop will, in general, be completely different.

In a third step 204, a digital signature is created by encrypting the hash of the
25 document using a private key. It will be appreciated that this private key might be the private key of any of a number of parties including, for example, the creator of the content, the owner of the content or the administrator of the content. The notion of an approved signing party with associated approved keys will be discussed below.
The hash of the document to be signed 302 and the digital signature 304 are
30 illustrated in Figure 3.

Once so created, the digital signature for the document to be signed may be stored on the appropriate storage device of the Web Server 100, in this example, the hard disk.

- 5 Alternatively in an optional fourth step 206, the digital signature so created is appended to the document to be signed to create a digitally signed document. The digitally signed document 306 is illustrated in Figure 3. The digitally signed document can then be stored on the appropriate storage device of the Web Server 100, in this example, the hard disk.

10

A document serving process according to the invention will be discussed having regard to Figures 1, 4, 5 and 6. Again, it will be appreciated that steps indicated in the procedural flowcharts will be carried out through execution of the software application running on the Web Server 100.

15

- Having regard to Figures 1 and 4, in a first step 400, the Web Server 100 receives a request from the second computer 114 for access to a given Web Page stored on the Web Server 100. As will be well known, this request will typically be initiated through the user of the second computer 114 clicking on a hyperlink, the Uniform Resource Locator (URL) of which points to the given Web Page. As will be further well known, the Web Server 100 will have a process monitoring TCP port 80 for receiving incoming connections from clients. Once a TCP connection has been established, then the HTTP request for the Web Page can be made as above.
- 20

- 25 In a second step 402, the Web Page corresponding to the URL request is retrieved from the appropriate storage device of the Web Server 100, in this example, the hard disk.

- In a third step 404 the digital signature corresponding to that Web Page is also retrieved from the appropriate storage device of the Web Server, in this example, the hard disk. It will be appreciated that if the digital signature had already been appended to the document in accordance with optional step 206 above, then this step would be performed upon retrieval of the document itself.
- 30

In a fourth step 406, the digital signature associated with the document is validated.

A procedural flowchart of the process of digital signature validation is illustrated in
5 Figures 5 and 6. This process of digital signature validation provided for in step 406
will now be discussed having regard to Figures 5 and 6 before returning to discussion
of the steps as illustrated in Figure 4. It will be appreciated that the structure of
Figures 5 and 6 is mirrored; Figure 5 illustrates a procedural flowchart of the process
of digital signature validation whilst Figure 6 illustrates in simple fashion the
10 behaviour of the corresponding entities.

Having regard to Figure 5, in a first step 500, the digital signature associated with the
document is decrypted with a public key, in this case the public key corresponding to
the private key first used to sign the hash or message digest of the document. As will
15 be well known this decryption will yield the hash of the document. The digital
signature 600 associated with the requested document and the hash 602 obtained
through the decryption are illustrated in Figure 6.

In a second step 502, the document is again run through the same hash function as
20 was originally used in the process of digitally signing the document. In this way a
new hash of the document is derived. The document 604 and the new hash of the
document 606 are illustrated in Figure 6.

It will be appreciated that if the public key used to decrypt the digital signature
25 associated with the requested document was not the matched public key for the
private key used to sign the hash of the document, then the digital signature will not
decrypt correctly. As a consequence, the hash of the document obtained through the
decryption will not be the correct one and will not be the same as the new hash of
the document. Similarly, it will be further appreciated that if the document has been
30 altered inbetween the signing of the document including the generation of the hash
and the generation of the new hash then the hash and the new hash will not be the
same.

Consequently, in a third step 504, the hash of the document and the new hash of the document are compared. The comparison of the hash of the document 602 and the new hash of the document 606 is figuratively illustrated in Figure 6.

- 5 If the hash and the new hash are identical then not only is it guaranteed that the party considered to have signed the document did in fact sign the document (i.e. the public key used in the decryption correctly matched the private key used to sign to document) but it is also guaranteed that the document has not been altered since generation of the digital signature (i.e. the hash of the document and the new hash of the document are identical). The comparison of the hash of the document and the new hash of the document returns a result to the authentication question posed in step 406. The digital signature associated with the requested document either passes the validation test or it does not.
- 10
- 15 Discussion of the document serving process may now return to a consideration of Figure 4.

If the digital signature is validated then, in a fifth step 408, the Web Server proceeds to send the Web Page to the requesting party, in conventional fashion.

- 20
- It is to be noted that, in a more general case, once the digital signature associated with a computer file has been validated, the server computer could allow access to the computer file other than sending the whole file at once to the client computer. By way of example, the server computer might instead open a communication session with the client computer and stream portions of the file to the client computer as required.
- 25

- 30
- If the digital signature is not validated however, which is to say that either the document has been altered since the digital signature associated with that document was created or that the document was in fact signed by someone other than who was represented as having signed the document, then the Web Server will not proceed to send the document at all. Instead, in a sixth step 410, the Web Server will

send a Web Page to the requesting party informing them that the Web Page that they have requested is not available.

In a seventh step 412, the Web Server might, for example, send a message to a
5 system administrator, containing a warning as to the invalid digital signature.

It is to be noted that, at the present time, public key operations are relatively slow, being of the order of 100 to 1000 times more slow than hash functions or symmetric key operations. If a Web Server were to be checking the digital signatures in respect
10 of every document served, it will be appreciated that this might quickly become a performance bottleneck. To ameliorate this problem, it is possible to use dedicated hardware boards optimised for the checking of digital signatures. One example of such a board is the one produced by nCipher of Cambridge, United Kingdom. Each such board will typically allow the checking of several hundred digital signatures per
15 second, with the possibility of daisy-chaining further boards as required.

As mentioned above, it is quite possible that there will be a number of parties who might wish to digitally sign one of 'their' documents. Each such party will have their own private key with which to perform the relevant encryption. It will thus be
20 necessary to provide a means by which each digitally signed file can be associated with the relevant signing party such that the appropriate matched public key can be used for the digital signature authentication.

One example of a means by which each digitally signed file may be associated with
25 the signing party is simply to attach a copy of the digital certificate of the signing party to the digitally signed file. Having regard to Figure 2, this might, for example, be performed in a further step following step 206. The well-known concept of the digital certificate, closely related to that of the digital signature, will not be discussed in any detail here. It will suffice to note that a digital certificate binds the identity of a party
30 to the public key of that party and is itself signed by a third party, usually denoted a Trusted Third Party (TTP).

In this way, having regard to Figure 4, when a digitally signed file is retrieved in steps 402 and 404, the attached digital certificate would also be retrieved. The digital certificate will provide the identity of the signing party and the associated public key of the signing party. Having regard to Figure 5, this public key may then be used in 5 step 500, to obtain the hash of the digitally signed document as required in the authentication process.

If the digital certificate attached to the file is not the digital certificate of the signing party then the authentication will fail. It is possible to consider however that an 10 unauthorised third party manages to smuggle a digitally signed file onto the Web Server with a matched digital certificate. A subsidiary problem which therefore arises is the controlling of which parties are authorised to sign documents for storing on that particular Web Site.

15 A list of authorised signing parties may be constructed and stored on the Web Server; only the digital certificates of the authorised signing parties may be validly used. Since the next point of attack for an unauthorised third party would be to try and add a false 'authorised' signing party to the list, this list may itself be secured by signing it with the private key of the system administrator. In this way, the list can only be 20 read using the public key of the system administrator which ensures, as with the discussion of the stored documents above, that the list has not been tampered with and does in fact originate from the system administrator.

Another issue which may be of interest is the ensuring that documents with a limited 25 'life' are not served after a predetermined time or date. Having regard to Figure 2, this might be achieved, in a further step following step 206, through the attachment of an 'expiry time- or date-stamp' to the digitally signed file. To prevent this expiry time- stamp being compromised, the digitally signed document with the attached expiry time-stamp might itself be signed in a yet further step with, for example, the private 30 key of the system administrator.

Having regard to Figure 4, in this instance when the digitally signed document is retrieved, in steps 404 and 404, the digitally signed document would have the expiry

time-stamp attached and would be signed by the system administrator. In a further step then, the expiry time-stamp could first be retrieved through the decryption of the digitally signed document with the public key of the system administrator. In a yet further step, a check could then be performed to see if the relevant time or date had
5 been passed. If the relevant time or date had been passed then the document would not be served.

A simple application of this embodiment according to the invention will now be discussed. The Web Server illustrated in Figure 1 is taken to host a corporate Web
10 Site. The Web Server will typically be protected by a corporate firewall as discussed above. Public computers having an Internet connection and being suitably equipped with Web Browsers might then be used to view Web Pages on this corporate Web Site. As will be well known these Web Pages might typically be used to present information about the company to the world at large.

15

A first situation might be considered where the company posts a document in the form of a Web Page on its corporate Web Site. The document has been digitally signed using the private company key in accordance with the above discussion of Figures 2 and 3. A member of the public requests access to this document, typically
20 by clicking on the hyperlink associated with the document. In accordance with the above discussion of Figures 4,5 and 6, the Web Server carries out an authentication of the digital signature of the document. In this first situation the authentication is successfully carried out and the Web Page served to the member of the public making the request without further ado.

25

A second situation might now be considered where again the company posts a document in the form of a Web Page on its corporate Web Site. The document has been digitally signed using, for example a private company key in accordance with the above discussion of Figures 2 and 3. In this situation however, unbeknownst to
30 the corporate Web Site administrator, the corporate firewall has been compromised and an unauthorised third party has gained access to the Web Server. Using this access, the unauthorised third party has then proceeded to alter one or more of the Web pages stored on the Web Server. The alterations effected by this unauthorised

third party will depend on their motives for mounting such an attack; it is however unfortunately easy to conceive of a range of such motives from pranks to outright sabotage.

- 5 A member of the public might now be considered as requesting access to a document which has been altered by the unauthorised third party. In accordance with the above discussion of Figures 4,5 and 6, the Web Server carries out an authentication of the digital signature of the document. In this second situation the authentication will fail due to the mismatch in the hash of the document and the new hash of the document.

10

The Web Page will therefore not be served to the member of the public making the request. Crucially, it will therefore not be possible for the member of the public making the request to see the altered document at all.

- 15 As indicated above, if the Web Page altered to suit the motives of an unauthorised third party intruder were allowed to be served to the member of the public making the request, albeit with a warning that the document was 'untrustworthy', then damage could nonetheless be done to the company's business or reputation.

- 20 A third situation might now be considered. In this situation, again unbeknownst to the corporate Web Site administrator, the corporate firewall has been compromised and an unauthorised third party has gained access to the Web Server. Using this access the unauthorised third party has posted a forged document in the form of a Web Page on the corporate Web Site of the company. The document has been digitally signed
25 by the third party in accordance with the above discussion of Figures 2 and 3 but the private key used in the signing process was one selected by the unauthorised third party rather than that of the company.

- A member of the public might now be considered as requesting access to a document
30 which has been altered by the unauthorised third party. In accordance with the above discussion of Figures 4,5 and 6, the Web Server carries out an authentication of the digital signature of the document. In this third situation the authentication will again fail. An attempt to decrypt the digital signature with the company public key when

the digital signature was signed with an unauthorised third party private key will again cause a mismatch to occur in the hash of the document and the new hash of the document.

- 5 Yet again the Web Page will therefore not be served to the member of the public making the request and again, crucially, it will therefore not be possible for the member of the public making the request to see the altered document at all.

10

15

CLAIMS

1. A server computer comprising:

5 means arranged to store one or more computer files;

means arranged to store one or more digital signatures;

each computer file having an associated digital signature;

10

means arranged to receive a request from at least one other computer for access to at least one computer file stored on said server computer;

means arranged to retrieve the or each requested computer file;

15

means arranged to retrieve the digital signature associated with the or each requested computer file;

means arranged to validate the digital signature associated with the or each
20 requested computer file; and

means arranged to provide said other computer with access to the or each requested computer file only when the digital signature associated with the or each respective requested computer file is valid.

25

2. A server computer as claimed in claim 1, in which said means arranged to provide said other computer with access to the or each requested computer file only when the digital signature associated with the or each respective requested computer file is valid comprises means arranged to provide to said other computer a copy of the
30 or each computer file only when the digital signature associated with the or each respective requested computer file is valid.

3. A server computer as claimed in claim 1 or claim 2 further comprising:

means arranged to store a list of approved computer file signing parties; each computer file signing party having at least one associated signing key with which to create digital signatures; and in which

5

said means arranged to validate the digital signature associated with the or each requested computer file only validates said digital signature if said digital signature was created with a signing key associated with an approved computer file signing party.

10

4. A server computer as claimed in any one of claims 1 to 3 further comprising a clock, wherein the or each computer file stored on said server computer has an associated expiry date; such that:

15

said means arranged to validate the digital signature associated with the or each requested computer file only validates said digital signature if the expiry date associated with the or each computer file is later than the current clock date.

5. A server computer arranged to store one or more computer files, one or more 20 digital signatures, each computer file having an associated digital signature, said server computer being arranged to perform the operation of:

receiving a connection from another computer;

25

receiving a request from said other computer for access to at least one computer file stored on said server computer;

retrieving the or each requested computer file;

30

retrieving the digital signature associated with the or each requested computer file;

validating the digital signature associated with the or each requested computer file; and

5 providing said other computer with access to the or each requested computer file only if the digital signature associated with the or each requested computer file is valid.

6. A method of operating a server computer comprising:

10 receiving a request from at least one other computer for access to at least one computer file stored on said server computer; each said computer file having an associated unique digital signature stored on said server computer;

15 retrieving the or each requested computer file;

retrieving the digital signature associated with the or each requested computer file;

20 validating the unique digital signature associated with the or each requested computer file; and

providing said other computer with access to the or each requested computer file only if the digital signature associated with the or each requested computer file is valid.

25

7. A method as claimed in claim 6, in which said providing said other computer with access to the or each requested computer file only if the digital signature associated with the or each requested computer file is valid comprises providing to said other computer a copy of the or each computer file only when the digital 30 signature associated with the or each requested computer file is valid.

8. A computer program storage medium, said medium embodying computer readable code for loading into a computer and executable by said computer to perform the method according to claim 6 or claim 7.

1/5

Fig. 1A.

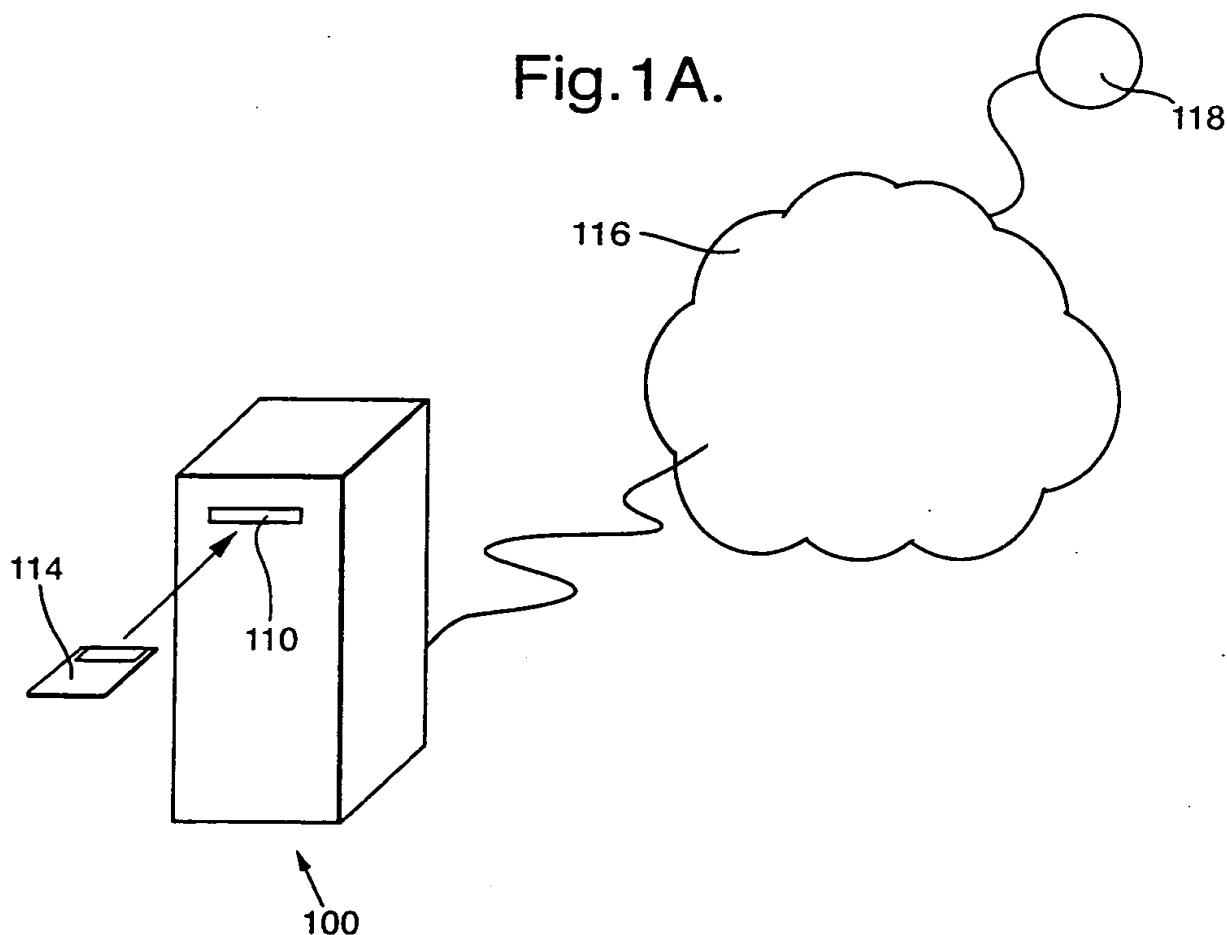


Fig. 1B.

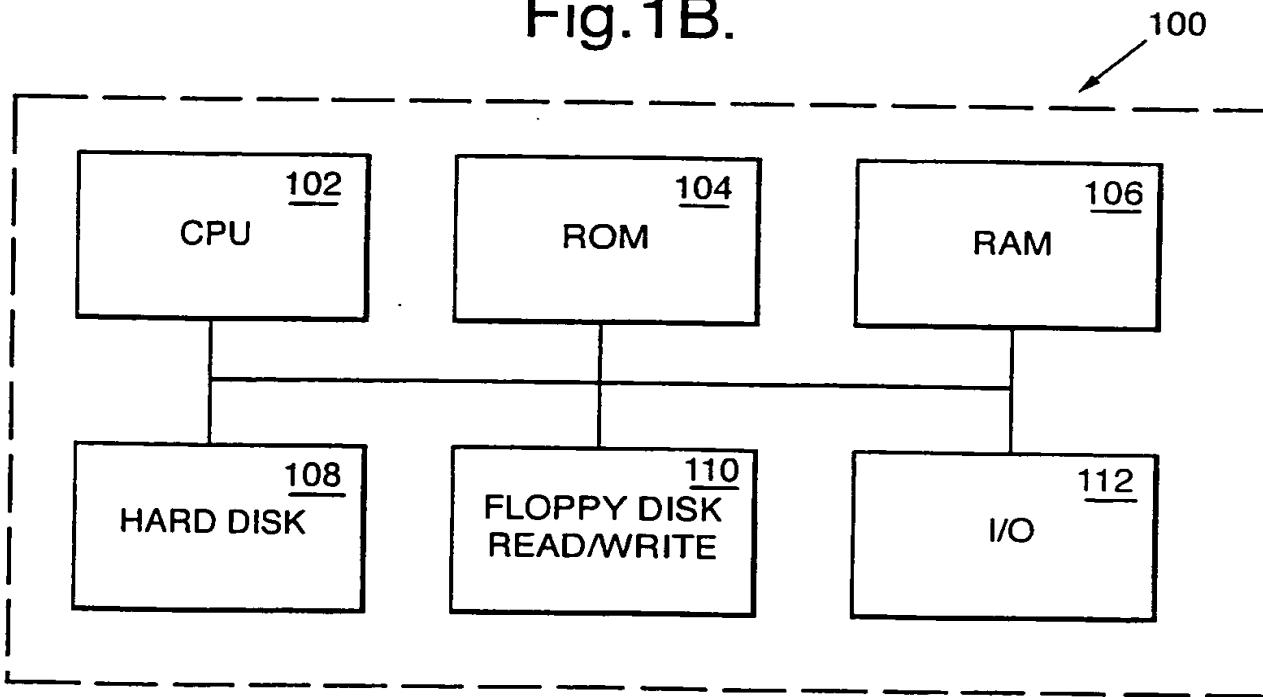


Fig.2..

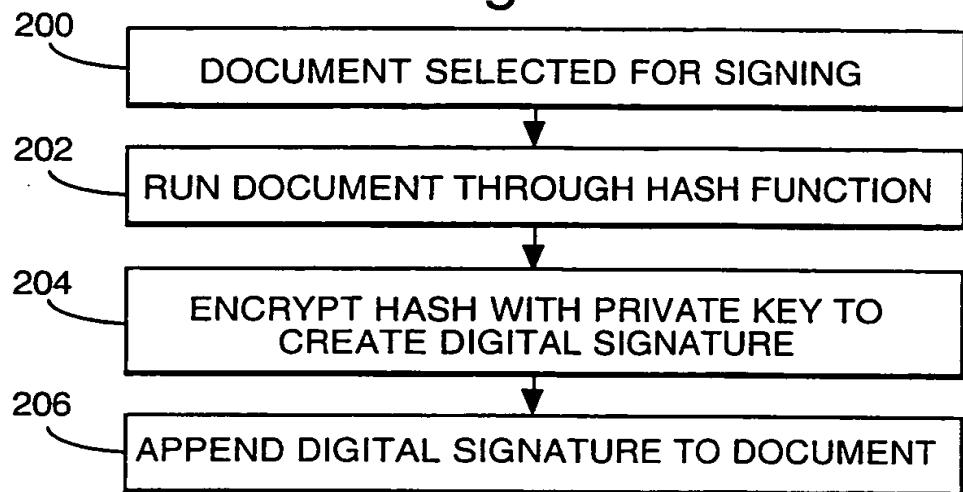


Fig.3.

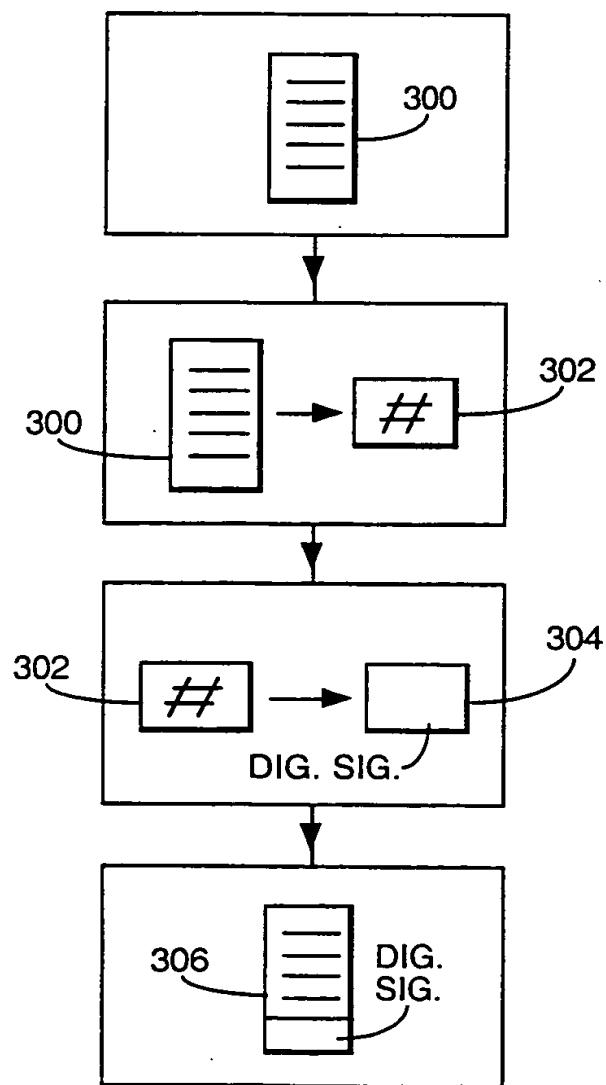


Fig.4.

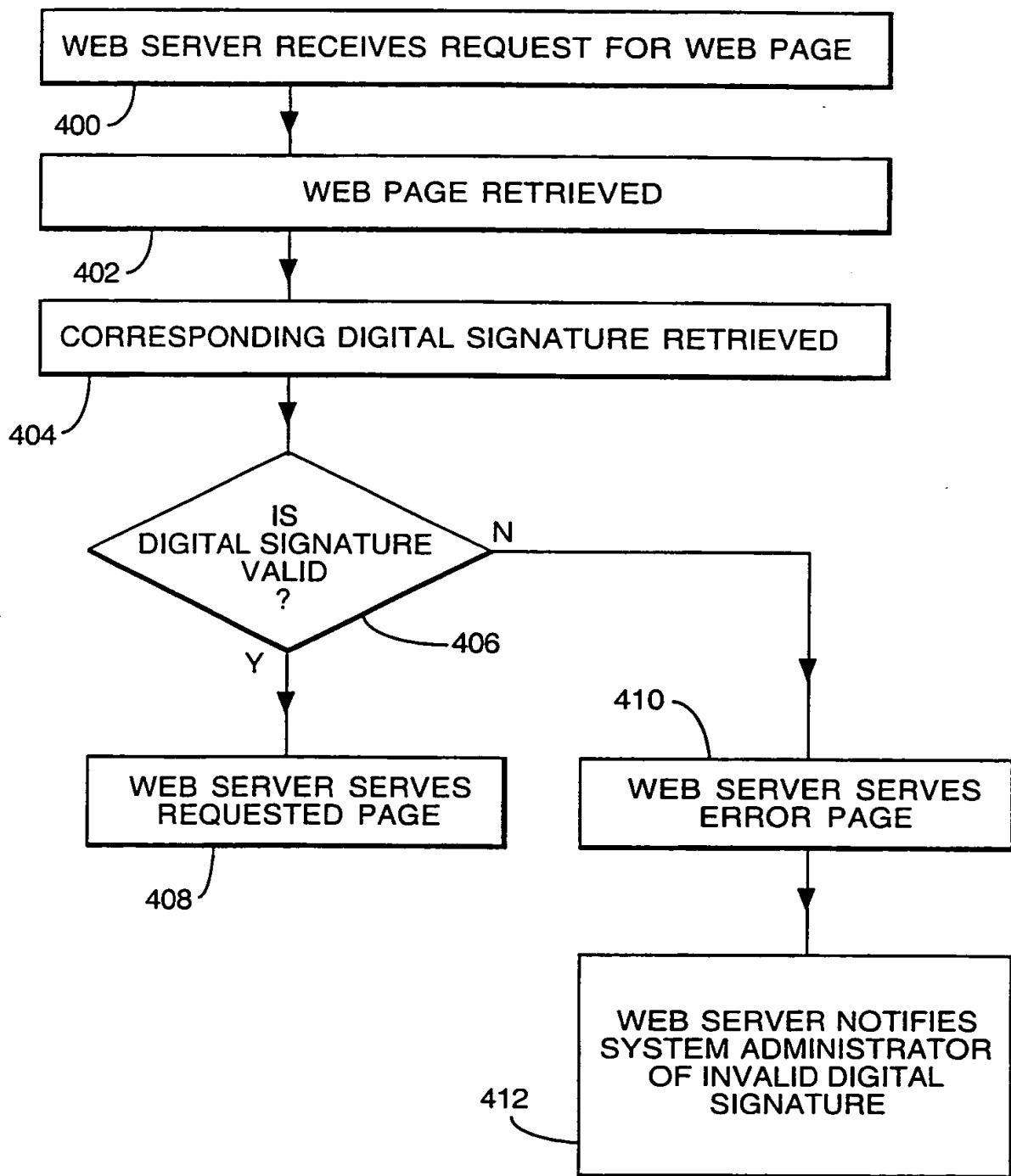


Fig.5.

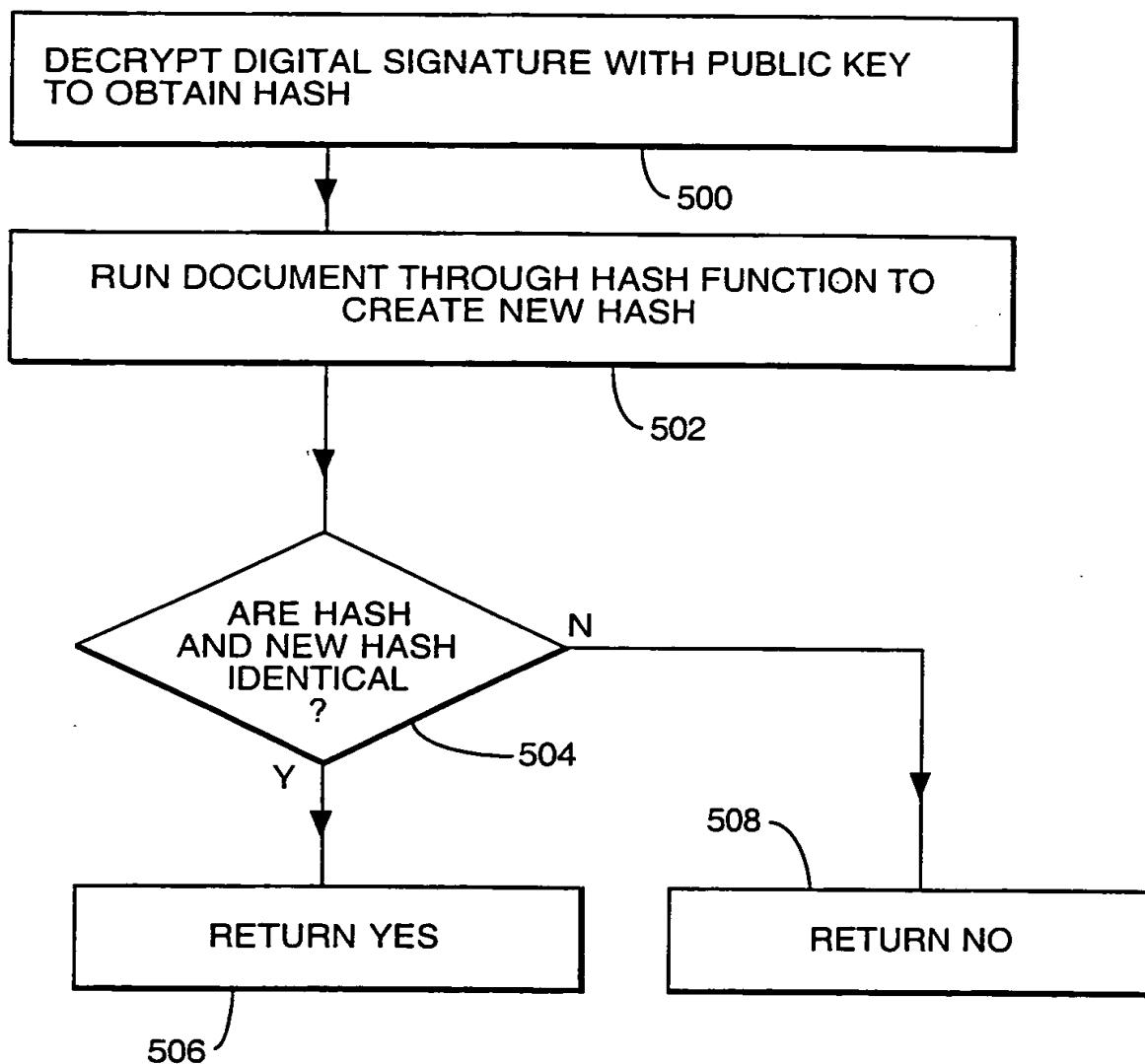
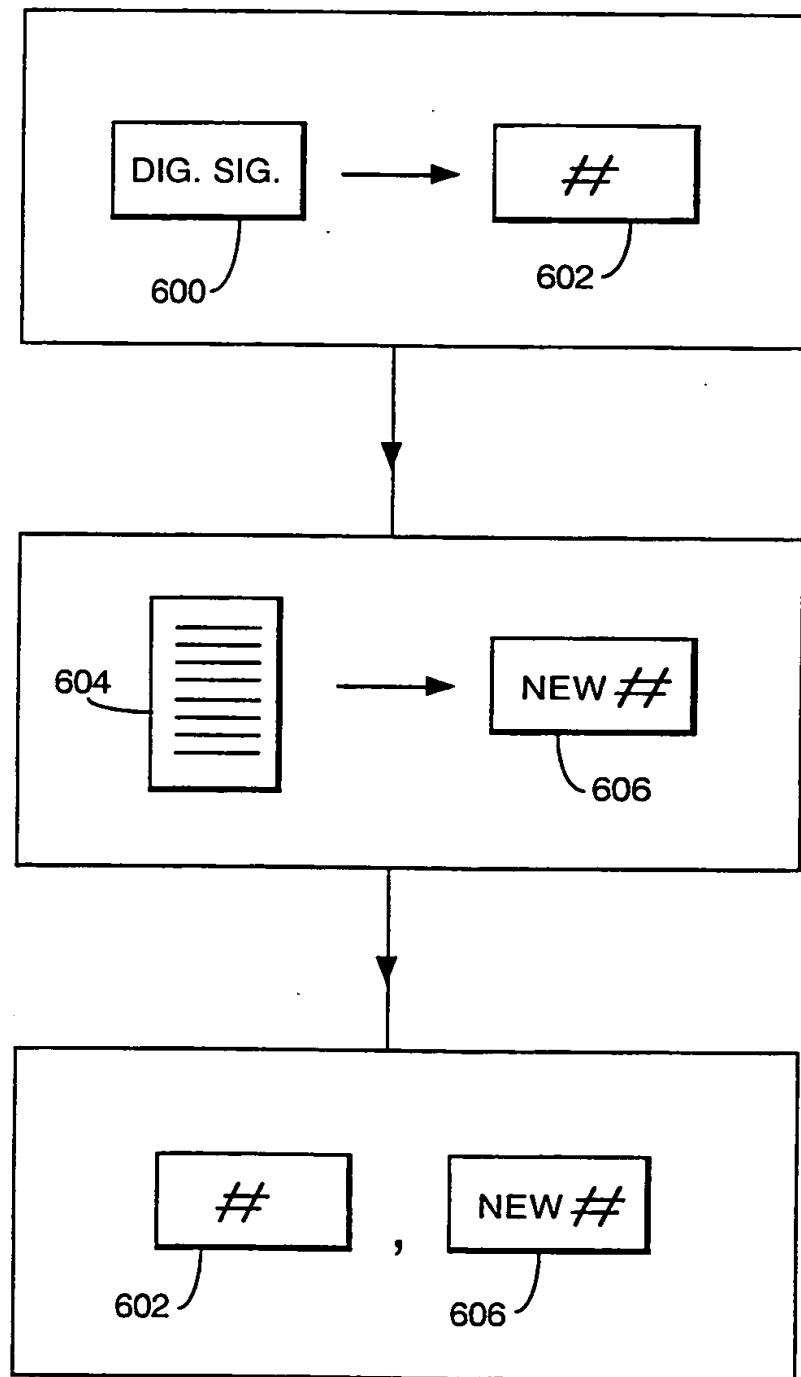


Fig.6.



INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/01078

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04L G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 835 943 A (DORWORTH GORDON L ET AL) 10 November 1998 (1998-11-10)	1,2,5-8
A	abstract column 2, line 41-61 column 6, line 8-37 column 8, line 5-23 column 13, line 30-43 figures 6-8	3,4
P,X	EP 0 915 600 A (HITACHI LTD) 12 May 1999 (1999-05-12) column 4, line 35-57 column 10, line 53 -column 11, line 16 column 12, line 36 -column 13, line 34 column 15, line 49 -column 16, line 4 column 21, line 51 -column 22, line 5 column 22, line 29-39	1-3,5-8

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

13 July 2000

Date of mailing of the international search report

21/07/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.
Fax: (+31-70) 340-3016

Authorized officer

Lázaro López, M.L.

INTERNATIONAL SEARCH REPORT

Inter. Application No.

PCT/GB 00/01078

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 781 711 A (KULBIDA CHRISTOPHER ET AL) 14 July 1998 (1998-07-14) abstract column 5, line 62 -column 6, line 42	1-8

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int'l Application No

PCT/GB 00/01078

Patent document cited in search report	Publication date	Patent family member(s)			Publication date
US 5835943	A 10-11-1998	US US	5682514 A 6012085 A		28-10-1997 04-01-2000
EP 0915600	A 12-05-1999	JP	11143840 A		28-05-1999
US 5781711	A 14-07-1998	US EP JP	5689625 A 0777176 A 9190319 A		18-11-1997 04-06-1997 22-07-1997

REPLACED
ARTICLE 34

In contrast with these present day approaches however, according to the invention there is provided a server computer comprising: means arranged to store one or more computer files; means arranged to store one or more digital signatures; each 5 computer file having an associated digital signature; means arranged to receive a request from at least one other computer for access to at least one computer file stored on said server computer; means arranged to retrieve the or each requested computer file; means arranged to retrieve the digital signature associated with the or each requested computer file; means arranged to validate the digital signature 10 associated with the or each requested computer file; and means arranged to provide said other computer with access to the or each requested computer file only when the digital signature associated with the or each respective requested computer file is valid.

15 Advantageously, in this way it is assured that if the computer file storage security is breached and one or more files tampered with, it will not be possible for any external party to see the results of the tampering. No access can be given to a computer file unless the digital signature associated with that computer file has been validated. In particular, no copy of a computer file can leave the file server computer where it is 20 stored unless the digital signature associated with that computer file has been validated. Thus, if the file has been tampered with, no external third party will be able to obtain a copy of it. There can be no possibility of the message or functionality of the original computer file being subverted by an unauthorised third party to their own ends.

25

A method of operating a server computer is also provided.

An embodiment of the invention by way of example will now be discussed with reference to the accompanying drawings in which:

30

Figure 1A represents first and second conventional computers connected to a communications network;

CLAIMS

1. A server computer comprising:

5 means arranged to store one or more computer files;

means arranged to store one or more digital signatures;

each computer file having an associated digital signature;

10 means arranged to receive a request from at least one other computer for access to at least one computer file stored on said server computer;

means arranged to retrieve the or each requested computer file;

15 means arranged to retrieve the digital signature associated with the or each requested computer file;

means arranged to validate the digital signature associated with the or each
20 requested computer file; and

means arranged to provide said other computer with access to the or each requested computer file only when the digital signature associated with the or each respective requested computer file is valid.

25 2. A server computer as claimed in claim 1, in which said means arranged to provide said other computer with access to the or each requested computer file only when the digital signature associated with the or each respective requested computer file is valid comprises means arranged to provide to said other computer a copy of the
30 or each computer file only when the digital signature associated with the or each respective requested computer file is valid.

3. A server computer as claimed in claim 1 or claim 2 further comprising:

means arranged to store a list of approved computer file signing parties;
each computer file signing party having at least one associated signing key
with which to create digital signatures; and in which

5

said means arranged to validate the digital signature associated with the or
each requested computer file only validates said digital signature if said digital
signature was created with a signing key associated with an approved computer file
signing party.

10

4. A server computer as claimed in any one of claims 1 to 3 further comprising
a clock, wherein the or each computer file stored on said server computer has an
associated expiry date; such that:

15

said means arranged to validate the digital signature associated with the or
each requested computer file only validates said digital signature if the expiry date
associated with the or each computer file is later than the current clock date.

20

5. A server computer arranged to store one or more computer files, one or more
digital signatures, each computer file having an associated digital signature, said
server computer being arranged to perform the operation of:

receiving a connection from another computer;

25

receiving a request from said other computer for access to at least one
computer file stored on said server computer;

retrieving the or each requested computer file;

30

retrieving the digital signature associated with the or each requested
computer file;

validating the digital signature associated with the or each requested computer file; and

5 providing said other computer with access to the or each requested computer file only if the digital signature associated with the or each requested computer file is valid.

6. A method of operating a server computer comprising:

10 receiving a request from at least one other computer for access to at least one computer file stored on said server computer; each said computer file having an associated unique digital signature stored on said server computer;

15 retrieving the or each requested computer file;

retrieving the digital signature associated with the or each requested computer file;

20 validating the unique digital signature associated with the or each requested computer file; and

providing said other computer with access to the or each requested computer file only if the digital signature associated with the or each requested computer file is valid.

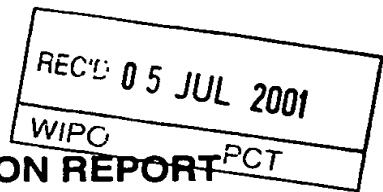
25 7. A method as claimed in claim 6, in which said providing said other computer with access to the or each requested computer file only if the digital signature associated with the or each requested computer file is valid comprises providing to said other computer a copy of the or each computer file only when the digital
30 signature associated with the or each requested computer file is valid.

8. A computer program storage medium, said medium embodying computer readable code for loading into a computer and executable by said computer to perform the method according to claim 6 or claim 7.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT



(PCT Article 36 and Rule 70)

Applicant's or agent's file reference A25770 WO	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/01078	International filing date (<i>day/month/year</i>) 22/03/2000	Priority date (<i>day/month/year</i>) 31/03/1999
International Patent Classification (IPC) or national classification and IPC H04L29/06		
<p>Applicant BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY</p>		
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 3 sheets.</p>		
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input checked="" type="checkbox"/> Certain defects in the international application VIII <input checked="" type="checkbox"/> Certain observations on the international application 		

Date of submission of the demand 28/07/2000	Date of completion of this report 03.07.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Haas, H Telephone No. +49 89 2399 8800



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/01078

I. Basis of the report

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-6,8-18	as originally filed
7	with telefax of 20/06/2001

Claims, No.:

1-6	with telefax of 20/06/2001
-----	----------------------------

Drawings, sheets:

1/5-5/5	as originally filed
---------	---------------------

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/01078

- the description, pages:
- the claims, Nos.:
- the drawings, sheets:
5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)): *(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*
6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 1-6
	No: Claims
Inventive step (IS)	Yes: Claims
	No: Claims 1-6
Industrial applicability (IA)	Yes: Claims 1-6
	No: Claims

**2. Citations and explanations
see separate sheet**

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

SECTION V

1. With respect to the subject-matter of claim 1, document D1 (US-A-5 835 943) discloses a server computer arrangement comprising:
means arranged to store one or more computer files (Figure 2, (80));
means arranged to store one or more digital signatures (Figure 2, (14, 42));
computer files having associated digital signatures (column 6, lines 23-26);
means arranged to receive a request from at least one other computer for access to at least one computer file stored on said server computer (Figure 2, (16));
means arranged to retrieve the or each requested computer file (Figure 2, (18));
means arranged to retrieve the digital signature associated with the or each requested computer file (Figure 2, (14));
means arranged to validate the digital signature associated with the or each requested computer file (Figure 2, (54)); and
means arranged to provide said other computer with access to the or each requested computer file when the digital signature associated with the or each respective requested computer file is valid (Figure 2, (24, 54) and column 6, lines 23-37).

There remains only the difference that according to claim 1 the validation process takes place within a single computer, whereas some sort of distributed computing is used according to D1, which is, however, not significant with respect to inventive step, in particular, as a hint towards system integration is given in D1 (column 5, lines 34-35).

The present application does thus not satisfy the criterion set forth in Article 33(3) PCT because the subject-matter of Claim 1 does not involve an inventive step (Rule 65(1)(2) PCT).

The applicant's argument that D1 may not explicitly disclose a denial of file access if the associated signature is invalid, can not be seen as adding any inventive activity to claim 1, as this is generally the purpose of using digital signatures.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01078

The same applies to independent claim 4 as well as to independent method claim 5 reciting the same features as claims 1 and 4 in terms of a method. This also applies to independent claim 6 as far as inventive activity can be assessed, because of lack of clarity (see section VIII below).

2. The subject-matter of dependent claims 2 to 4 only covers implementation details which are either rendered obvious by the documents of the International Search Report or lie fully within the normal capabilities of a person skilled in the art.

Therefore the dependent claims do not add anything of inventive significance to claim 1.

SECTION VII

The independent claims are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (presumably document D1) being placed in a preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in a characterising part (Rule 6.3(b)(ii) PCT).

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D2 (EP-A-0 915 600) are not mentioned in the description, nor are these documents identified therein.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01078

SECTION VIII

Although claims 1 and 4 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness (Article 6 PCT).

It is clear from the description and the drawings that at least all features of claim 5 are essential to the definition of the claimed subject-matter. Since independent claim 6 does not contain these features it does not meet the requirement following from Article 6 PCT taken in combination with Rule 6.3(b) PCT that any independent claim must contain all the technical features essential to the definition of the invention.

Furthermore claim 6 tries to define an apparatus in terms of method features. Therefore claim 6 is also not clear with regard to category.

In contrast with these present day approaches however, according to the invention there is provided a server computer comprising: means arranged to store one or more computer files; means arranged to store one or more digital signatures; each 5 computer file having an associated digital signature; means arranged to receive a request from at least one other computer for access to at least one computer file stored on said server computer; means arranged to retrieve the or each requested computer file; means arranged to retrieve the digital signature associated with the or each requested computer file; means arranged to validate the digital signature 10 associated with the or each requested computer file; and means arranged to deny said other computer access to the or each requested computer file if the digital signature associated with the or each respective requested computer file is invalid.

Advantageously, in this way it is assured that if the computer file storage 15 security is breached and one or more files tampered with, it will not be possible for any external party to see the results of the tampering. No access can be given to a computer file unless the digital signature associated with that computer file has been validated. In particular, no copy of a computer file can leave the file server computer where it is stored unless the digital signature associated with that computer file has 20 been validated. Thus, if the file has been tampered with, no external third party will be able to obtain a copy of it. There can be no possibility of the message or functionality of the original computer file being subverted by an unauthorised third party to their own ends.

25 A method of operating a server computer is also provided.

An embodiment of the invention by way of example will now be discussed with reference to the accompanying drawings in which:

30 Figure 1A represents first and second conventional computers connected to a communications network;

Figure 1B represents such a conventional computer;

19

CLAIMS

1. A server computer comprising:
 - means arranged to store one or more computer files;
 - 5 means arranged to store one or more digital signatures; each computer file having an associated digital signature;
 - means arranged to receive a request from at least one other computer for access to at least one computer file stored on said server computer;
 - means arranged to retrieve the or each requested computer file;
 - 10 means arranged to retrieve the digital signature associated with the or each requested computer file;
 - means arranged to validate the digital signature associated with the or each requested computer file; and
 - means arranged to deny said other computer access to the or each requested computer file if the digital signature associated with the or each respective requested computer file is invalid.
 2. A server computer as claimed in claim 1 further comprising:
 - means arranged to store a list of approved computer file signing parties;
 - 20 each computer file signing party having at least one associated signing key with which to create digital signatures; and in which
 - means arranged to validate the digital signature associated with the or each requested computer file invalidates said digital signature if said digital signature was created with a signing key not associated with an approved computer file signing party.
 - 25 3. A server computer as claimed in any one of claims 1 to 2 further comprising a clock, wherein the or each computer file stored on said server computer has an associated expiry date; such that:
 - 30 said means arranged to validate the digital signature associated with the or each requested computer file invalidates said digital signature if the current clock date is later than the expiry date associated with the or each computer file.

20

4. A server computer arranged to store one or more computer files, one or more digital signatures, each computer file having an associated digital signature, said server computer being arranged to perform the operation of:

receiving a connection from another computer;

5 receiving a request from said other computer for access to at least one computer file stored on said server computer;

retrieving the or each requested computer file;

retrieving the digital signature associated with the or each requested computer file;

10 validating the digital signature associated with the or each requested computer file; and

denying said other computer access to the or each requested computer file if the digital signature associated with the or each requested computer file is invalid.

15 5. A method of operating a server computer comprising:

receiving a request from at least one other computer for access to at least one computer file stored on said server computer; each said computer file having an associated unique digital signature stored on said server computer;

retrieving the or each requested computer file;

20 retrieving the digital signature associated with the or each requested computer file;

validating the unique digital signature associated with the or each requested computer file; and

25 providing said other computer with access to the or each requested computer file only if the digital signature associated with the or each requested computer file is valid.

6. A computer program storage medium, said medium embodying computer readable code for loading into a computer and executable by said computer to 30 perform the method according to claim 5.